

Martin Bush - DVD TECHNOLOGY

DVD is an optical disc storage media format that can be used for data storage, including movies with high video and sound quality. DVDs resemble compact discs as their physical dimensions are the same (12cm in diameter) but they are encoded in a different format and at a much higher density, using the Universal Disk Format (UDF) file system. The official DVD specification is maintained by the DVD Forum.

History

In the early 1990s two high density optical storage standards were being developed: one was the MultiMedia Compact Disc (MMCD), backed by Philips and Sony, and the other was the Super Density Disc (SD), supported by Toshiba, Time-Warner, Matsushita Electric, Hitachi, Mitsubishi Electric, Pioneer, Thomson, and JVC. Philips and Sony abandoned their MMCD format and agreed upon Toshiba's SD format with two modifications that are both related to the servo tracking technology. The result was the DVD specification Version 1.0, announced in 1995 and finalized in September 1996. The major developers, 11 in all, created an uneasy alliance under what later became known as the DVD Forum. DVD has, in the few years since, grown to include variations that do anything that CD does, and more efficiently. Standardization and compatibility issues aside, DVD is well-placed to supplant CD.

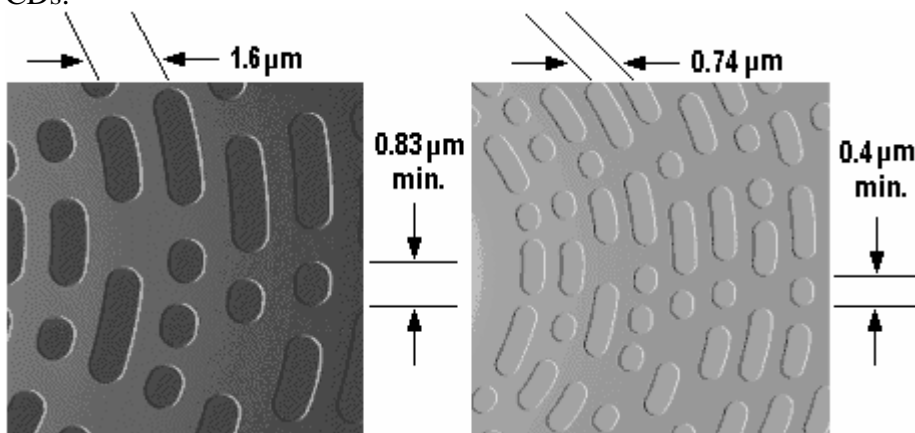
"DVD" was originally an initialism for "Digital Video Disc". Some members of the DVD Forum believe that it should stand for "Digital Versatile Disc" to reflect its widespread use.

Technology

DVDs are made from a 0.6 mm thick disc of polycarbonate plastic coated with a much thinner (reflective) aluminium layer. Two such discs are glued together to form a 1.2 mm double-sided disc. It's also true that DVD's seven-fold increase in data capacity over the CD .

What are the main differences between DVD and CD?

Firstly, the tracks are placed closer together, thereby allowing more tracks per disc. The DVD track pitch (the distance between each) is reduced to 0.74 micron, less than half of CD's 1.6 micron. The pits, in which the data is stored, are also a lot smaller, thus allowing more pits per track. The minimum pit length of a single layer DVD is 0.4 micron as compared to 0.834 micron for a CD. With the number of pits having a direct bearing on capacity levels, DVD's reduced track pitch and pit size alone give DVD-ROM discs four times the storage capacity of CDs.



The packing of as many pits as possible onto a disc is, however, the simple part and DVD's real technological breakthrough was with its laser. Smaller pits mean that the laser has to produce a smaller spot, and DVD achieves this by reducing the laser's wavelength from the 780nm (nanometers) infrared light of a standard CD, to 635nm or 650nm red light.

Secondly, the DVD specification allows information to be scanned from more than one layer of a DVD simply by changing the focus of the read laser. Instead of using an opaque reflective layer, it's possible to use a translucent layer with an opaque reflective layer behind carrying more data. This doesn't quite double the capacity because the second layer can't be quite as dense as the single layer, but it does enable a single disc to deliver 8.5GB of data without having to be removed from the drive and turned over. In standard-density CDs, the information is always stored first near the hub of the disc. The same will be true for single- and dual-layer DVD, but the second layer of each disc can contain data recorded "backwards", or in a reverse spiral track. With this feature, it takes only an instant to refocus a lens from one reflective layer to another. On the other hand, a single-layer CD that stores all data in a single spiral track takes longer to relocate the optical pickup to another location on the same surface.

Thirdly, DVD allows for allows for double-sided discs.

Finally, DVD has made the structure of the data put on the disc more efficient. When CD was developed in the late 1970s, it was necessary to build in some heavy-duty and relatively crude error correction systems to guarantee the discs would play. When bits are being used for error detection they are not being used to carry useful data. DVD uses effective error correction code (ECC) that leaves more room for real data.

A DVD can contain:

DVD-Video (containing movies (video and sound))

DVD-Audio (containing high-definition sound)

DVD-Data (containing data)

The disc medium can be:

DVD-ROM (read only, manufactured by a press)

DVD-R/RW (R = Recordable once, RW = ReWritable)

DVD-RAM (random access rewritable)

DVD+R/RW (R = Recordable once, RW = ReWritable)

DVD-R DL (double layer)

DVD+R DL (double layer)

The disc may have one or two sides, and one or two layers of data per side; the number of sides and layers determines the disc capacity.

DVD-5: single sided, single layer, 4.7 gigabytes (GB),

DVD-9: single sided, double layer, 8.5 GB (7.92 GiB)

DVD-10: double sided, single layer on both sides, 9.4 GB (8.75 GiB)

DVD-14: double sided, double layer on one side, single layer on other, 13.3 GB (12.3 GiB)

DVD-18: double sided, double layer on both sides, 17.1 GB (15.9 GiB)

The capacity of a DVD-ROM can be visually determined by noting the number of data sides, and looking at the data side(s) of the disc. Double-layered sides are sometimes gold-colored. Single-layered sides are silver-colored, like a CD. One additional way to tell if a DVD contains one or two layers is to look at the center ring on the underside of the disc. If there are two barcodes, it is a dual layer disc. If there is one barcode, there is only one layer.

The DVD Forum created the official DVD-ROM/R/RW/RAM standards and the DVD+RW Alliance (The DVD+RW Alliance is a group of electronic hardware, optical storage and software manufacturers who created and promote a format standard of recordable and rewritable DVDs, known as the "plus" format. As of 2004, plus format DVDs come in three forms: DVD+R, DVD+RW and DVD+R DL

Since DVD+R/RW discs are not technically DVDs as per the DVD Forum standards, they are not allowed to display the DVD logo; instead, they display an "RW" logo (even if it is not re-writable, something some consider deceptive advertising). However, they are readable by most DVD drives, so they are referred to as DVD+R and DVD+RW.

The "+" (plus) and "-" (dash) are similar technical standards and are partially compatible. As of 2004, both formats are equally popular, with about half of the industry supporting "+", and the other half "-". All DVD readers are supposed to read both formats, though real-world compatibility is around 90% for both formats, with DVD-R having the best overall compatibility in independent tests. Most new DVD writers can write both formats and carry both the RW and DVD logos.

The data transfer rate of a DVD drive is given in multiples of 1350 kB/s, which means that a drive with 16x speed designation allows a data transfer rate of $16 \times 1350 = 21600$ kB/s (21.09 MB/s). As CD drive speeds are given in multiples of 150 kB/s, one DVD "speed" equals nine CD "speeds", so an 8x DVD drive should have a data transfer rate similar to that of a 72x CD drive. In physical rotation terms (spins per second), one DVD "speed" equals three CD "speeds", so an 8x DVD drive has the same rotational speed as 24x CD drive.

Early CD and DVD drives read data at a constant rate. Most current CD and DVD drives have a constant rotation speed (Constant Angular Velocity, or CAV). The maximum data rate specified for the drive/disc is achieved only at the end of the disc's track. The average speed of the drive therefore equals to only about 50–70% of the maximum speed.

Although DVD was once thought of as being solely a video format, there are several other DVD specifications:

DVD-ROM

Digital Versatile disc - Read Only Memory (DVD-ROM) is a DVD format with technology similar to the familiar DVD video disk, but with a more computer-friendly file structure. The DVD-ROM format was designed to store the same type of computer data typical of a CD-ROM, and is intended for use in DVD-ROM drives in a personal computer. DVD-ROMs have seven times the storage capacity of CD-ROMs. DVD-ROM specifications were detailed in the original 1997 document, Book A. A DVD-ROM drive is similar to the CD-ROM drive. DVD-ROM drives are backward compatible, and can read CD-ROMs, usually at speeds comparable to a 24X or 32X CD-ROM drive.

DVD-RAM

Digital Versatile disc - Random Access Memory (DVD-RAM) is an adaptation of DVD-ROM that uses magneto-optical technology to record data. DVD-RAM specifications, known as Book E, were released by the DVD Forum in 1998. Like most DVD formats, DVD-RAM can contain any type of information, such as video, text, audio, and computer data. DVD-

RAM disks can be read by DVD-ROM drives. Long durability of minimum 30 years. Can be rewritten > 100,000 times

DVD-Audio

DVD-Audio (DVD-A) is a DVD format developed by Panasonic that is specifically designed to hold audio data, and particularly, high-quality music. The DVD Forum released the final DVD-A specification in March of 1999. The new DVD format provides at least twice the sound quality of audio CD on disks that can contain up to seven times as much information. Various types of DVD-A-compatible DVD players are being manufactured, in addition to the DVD-A players specifically developed for the format. DVD-A is backed by most of the industry as the technology that will replace the standard audio CD. The major exceptions are Philips and Sony, whose Super Audio provides similar audio quality. Like DVD-A, SACD offers 5.1 channel surround sound in addition to 2-channel stereo. Both formats improve the complexity of sound by increasing bit rates and sampling frequencies and can be played on existing CD players, although only at quality levels similar to those of traditional CDs.

DVD-R

Digital Versatile disc - Recordable (DVD-R) is a type of write once DVD format that allows the user to record a single time on a DVD disk. DVD-R specifications, known as Book D, were released by the DVD Forum in 1997. Similarly to CD-R, DVD-R can contain any type of information, such as video, text, audio, and computer data, for example. DVD-R disks can be played on any type of DVD playback device that can handle the type of information stored, such as a DVD-ROM drive, or a DVD video player. DVD-R disks are read at the same speeds as commercially made DVDs.

DVD+R

A DVD+R is a writable optical disc with 4.7 GB (4.38 GiB) of storage capacity.

The format was developed by a coalition of corporations, known as the DVD+RW Alliance, in mid 2002. Since the DVD+R format is a competing format to the DVD-R format, which is developed by the DVD Forum. It has not been approved by the DVD Forum, which claims that the DVD+R format is not an official DVD format. DVD+R discs can only be written to once. The DVD+R format is divergent from the DVD-R format. Hybrid drives that can handle both, often labeled "DVD±RW".

DVD-RW

Digital Versatile disc - Rewritable (DVD-RW) is a DVD format that allows the user to record and erase multiple times on a single DVD disk. DVD-RW specifications were released as Book F in 1999 by the DVD Forum. A slightly different rewritable DVD format, DVD+RW is backed by a group of companies known as the DVD+RW Consortium, made up of Philips, Sony, Hewlett-Packard, Mitsubishi Chemical, Yamaha, and Ricoh. According to Pioneer, DVD-RW discs may be written to about 1,000 times before needing replacement, making them comparable with the CD-RW standard. DVD-RW discs are commonly used for volatile data, such as backups or collections of files. They are also increasingly used for home DVD video recorders. A DVD-RW is a rewritable optical disc with equal storage capacity to a DVD-R, typically 4.7 GB.

DVD+RW

A DVD+RW is a rewritable optical disc with equal storage capacity to a DVD+R, typically 4.7 GB. The format was developed by a coalition of corporations, known as the DVD+RW Alliance, in late 1997. It was heavily revised and the capacity increased from 2.8 GB to 4.7 GB in 2001. One competing rewritable format is DVD-RW. Hybrid drives that can handle both, often labeled "DVD±RW".

DVD+RW discs can be rewritten about 1,000 times, making them comparable with the CD-RW standard. DVD+RW discs are commonly used for volatile data, such as backups or collections of files. However, they are not as widely used for home DVD video recorders as DVD-RW, primarily because they were originally designed for storage of data, rather than of video.

DVD-R DL

DVD-R DL (Dual Layer) (Also Known as DVD-R9) is a derivative of the DVD-R format standard. DVD-R DL discs employ two recordable dye layers, each capable of storing nearly the 4.7 GB of a single-layer disc, almost doubling the total disc capacity to 8.54 GB. Discs can be read in many DVD devices and can only be written using DVD±RW DL burners.

DVD+R DL

DVD+R DL (Double Layer), also known as DVD+R9, is a derivative of the DVD+R format created by the DVD+RW Alliance. Its use was first demonstrated in October 2003. DVD+R DL discs employ two recordable dye layers, each capable of storing nearly the 4.7 GB of a single-layer disc, almost doubling the total disc capacity to 8.55 GB. Discs can be read in many DVD devices and can only be created using DVD+RW DL and Super Multi drives.

DVD-Video

DVD-Video discs require a DVD-drive with a MPEG-2 decoder (e.g. a DVD-player or a DVD computer drive with a software DVD player). Commercial DVD movies are encoded using a combination of MPEG-2 compressed video and audio of varying formats (often multi-channel formats as described below). Typical data rates for DVD movies range from 3–10 Mbit/s. The video resolution on NTSC discs is 720×480 and on PAL discs is 720×576 . A high number of audio tracks and/or lots of extra material on the disc will often result in a lower bit rate (and image quality) for the main feature.

The audio data on a DVD movie can be of the format PCM, DTS, MP2, or Dolby Digital (AC-3).

DVDs can contain more than one channel of audio to go together with the video content. DVD Video may also include one or more subtitle tracks in various languages, including those made especially for the hearing impaired. They are stored as images with transparent background which are overlaid over the video during playback. Subtitles are restricted to four colors and thus tend to look cruder than permanent subtitles on film.

DVD Video may contain Chapters for easy navigation (and continuation of a partially watched film). If space permits, it is also possible to include several versions (called "angles") of certain.

DVD-Video has four complementary systems designed to restrict the DVD user in various ways: Macrovision, Content Scrambling System (CSS), region codes, and disabled user operations (UOPs).

The Future of CD/DVD Technology

Nevertheless, the future is hard to predict. The industry moves forward, and newer technologies, such as HD-DVD and Blue Ray, are being developed.